AMENDMENTS TO THE CLAIMS

1. (Currently Amended) A refrigerator ~~having~~comprising:

a first compressor for compressing a coolant,

a first radiator for radiating heat from the first coolant,

a first flow control valve for regulating ~~the~~ flow volume of the first coolant,

~~and an~~a first evaporator for evaporating the first coolant, ~~characterized in that the refrigerator includes:~~,

~~a~~ coolant cooling means for cooling the first coolant~~;~~, and

~~a~~ heat-exchange-amount control means for controlling ~~the amount~~quantity of heat exchanged in the coolant cooling means~~;~~, wherein the first coolant is circulated through the first compressor, the first radiator, the coolant cooling means, the first flow control valve, and the first evaporator, in that sequence.

2. (Currently Amended) ~~A~~The refrigerator as ~~recited~~claimed in claim 1, utilizing a nonflammable coolant ~~whose~~having a global warming potential ~~is~~ lower than that of chlorofluorocarbon, wherein the coolant cooling means includes:

a second compressor for compressing a second coolant ~~whose~~having an energy consumption efficiency ~~is~~ higher than that of the first coolant;

a condenser for radiating heat from the second coolant;

a second flow control valve for regulating ~~the~~ flow volume of the second coolant; and

a second evaporator for evaporating, ~~by means of~~with heat from the first coolant, the second coolant~~;~~ wherein the second coolant is circulated through the second compressor, the condenser, the second flow control valve, and the second evaporator, in that sequence.

3. (Currently Amended) ~~A~~The refrigerator as ~~recited~~claimed in claim 1, wherein the compressor ~~having~~comprises an intermediary-pressure inlet for drawing in the first coolant during compressing, the refrigerator further comprising:

a gas-liquid separator for separating into gas and liquid the first coolant ~~as outputted~~output from the first flow control valve;

a bypass pipe for introducing into the intermediary-pressure inlet at least part ~~or all~~ of the gas of the first coolant ~~gas~~ separated by the gas-liquid separator; and

a third flow control valve for regulating the flow volume of the first coolant ~~as outputted~~output from the gas-liquid separator and ~~inputted~~input into the first evaporator.

4. (Currently Amended) ~~A~~The refrigerator as ~~recited~~claimed in claim 1, further comprising:

a ~~third~~second compressor for compressing the first coolant ~~as~~ compressed by the first compressor;

a gas-liquid separator for separating into gas and liquid the first coolant ~~as outputted~~output from the first flow control valve;

a bypass pipe for introducing into the ~~third~~second compressor at least part ~~or all~~ of the gas of the first coolant ~~gas~~ separated by the gas-liquid separator; and

a ~~third~~second flow control valve for regulating ~~the~~ flow volume of the first coolant ~~as outputted~~output from the gas-liquid separator and ~~inputted~~input into the first evaporator~~;~~, wherein the first coolant ~~as outputted~~output from the ~~third~~second compressor is ~~inputted~~input into the first radiator.

5. (Currently Amended) ~~A~~The refrigerator as ~~recited~~claimed in claim 1, further comprising:

a ~~third~~second radiator for radiating heat from the first coolant ~~as outputted~~output from the first compressor; and

a ~~third~~second compressor for compressing the first coolant in a state in which heat of the first coolant has been radiated ~~away~~ by the ~~third~~second radiator~~;~~, wherein the first coolant ~~is flowed~~flows through the ~~third~~second radiator, the ~~third~~second compressor, and the first radiator, in that sequence.

6. (Currently Amended) ~~A~~The refrigerator as ~~recited~~claimed in claim 2, further comprising:

a third compressor for compressing the first coolant ~~as~~ compressed by the first compressor; and

a ~~third~~ heat exchanger for exchanging heat between the first coolant and the second coolant~~;~~, wherein

the first coolant ~~as outputted~~output from the first compressor ~~is flowed~~flows through the ~~third~~ heat ~~exchanger,~~exchange the third compressor, and the first radiator, in that sequence~~;~~, and

the second coolant ~~as outputted~~output from the second evaporator ~~is flowed~~flows through the ~~third~~ heat exchanger~~;~~ and the second compressor, in that sequence.

7. (Currently Amended) ~~A~~The refrigerator as ~~recited~~claimed in claim 2, further comprising:

a third compressor for compressing the first coolant ~~as~~ compressed by the first compressor;

a ~~third~~ heat exchanger for exchanging heat between the first coolant and the second coolant; and

a ~~forth~~third flow control valve for regulating ~~the~~ flow volume of the second coolant flowing in the ~~third~~ heat exchanger~~;~~, wherein

the first coolant ~~as outputted~~output from the first compressor ~~is flowed~~flows through the ~~third~~ heat exchanger, the third compressor, and the first radiator, in that sequence, and

part of the second coolant ~~as outputted~~output from the condenser ~~is flowed~~flows through the ~~forth~~third flow control valve, the ~~third~~ heat exchanger, and the second compressor, in that sequence.

8. (Currently Amended) ~~A~~The refrigerator as ~~recited~~claimed in claim 1, wherein the heat-exchange-amount control means includes:

~~a~~ drying-ratio estimation means for estimating, by a measured value using a ~~predetermined~~ sensor, a drying ratio ~~that is a ratio~~ between ~~a~~ drying rate of the first coolant ~~at the exit of~~exiting the first flow control valve and ~~a~~ drying rate when the first coolant ~~at the exit of~~exiting the first radiator is decompressed to its evaporation temperature;

~~a~~ drying-ratio control-range determination means for determining a control range of the drying ratio, so that a coefficient of performance (COP) value is obtained, in which the difference between the COP value and the maximum COP value obtained when the drying ratio is varied under predetermined operational conditions is within a predetermined range; and

~~a~~ control means for controlling the ~~amount~~quantity of heat exchanged in the coolant cooling means, so that the drying ratio estimated by the drying-ratio estimation means is within the control range.

9. (Currently Amended) ~~A~~The refrigerator as ~~recited~~claimed in claim 2, wherein the heat-exchange-amount control means includes:

~~a~~ drying-ratio estimation means for estimating, by a measured value using a ~~predetermined~~ sensor, a drying ratio ~~that is a ratio~~ between ~~a~~ drying rate of the first coolant ~~at the exit of~~exiting the first flow control valve and ~~a~~ drying rate when the first coolant ~~at the exit of~~exiting the first radiator is decompressed to its evaporation temperature;

~~a~~drying-ratio control-range determination means for determining a control range of the drying ratio, so that a coefficient of performance (COP) value is obtained, in which the difference between the COP value and the maximum COP value obtained when the drying ratio is varied under predetermined operational conditions is within a predetermined range; and

~~a~~control means for controlling the flow volume of the second coolant flowing in the coolant cooling means, so that the drying ratio estimated by the drying-ratio estimation means is within the control range.

10. (Currently Amended) ~~A~~The refrigerator as ~~recited~~claimed in ~~either~~claim 8~~or claim 9~~, wherein the ~~predetermined~~sensor includes:

at least one of ~~a~~first pressure-measuring means for measuring pressure of the first coolant between ~~the exit of~~exiting the first flow control valve and ~~the entrance~~entering of the evaporator, and ~~a~~first temperature-measuring means for measuring temperature of the first coolant ~~at the exit of~~exiting the first flow control valve;

~~a~~second pressure-measuring means for measuring pressure of the first coolant between the first compressor and the first flow control valve;

~~a~~second temperature-measuring means for measuring temperature of the first coolant ~~at the entrance of~~entering the first flow control valve; and

~~a~~third temperature-measuring means for measuring temperature of the first coolant ~~at the exit of~~exiting the first radiator.

11. (Currently Amended) ~~A~~The refrigerator as ~~recited~~claimed in ~~either~~claim 8~~or claim 9~~, wherein the ~~predetermined~~sensor includes:

~~a~~first temperature-measuring means for measuring temperature of the first coolant ~~at the exit of~~exiting the first flow control valve;

~~a~~second temperature-measuring means for measuring temperature of the first coolant ~~at the entrance of~~entering the first flow control valve;

~~a~~third temperature-measuring means for measuring temperature of the first coolant ~~at the exit of~~exiting the first radiator;

~~a forth~~fourth temperature-measuring means for measuring temperature of the first coolant ~~at the entrance of~~entering the first radiator; and

~~a~~fifth temperature-measuring means for measuring temperature of the first coolant ~~at the entrance of~~entering the first compressor.

12.(Currently Amended) ~~A~~The refrigerator as ~~recited~~claimed in claim 1, further comprising:

~~a second~~first temperature-measuring means for measuring first flow-control-valve entrance temperature as ~~coolant~~ temperature ~~at the entrance~~ of the first coolant entering the first flow control valve~~;~~, wherein the heat-exchange-amount control means includes:

~~a~~ flow-control-valve-entrance-temperature control-range determination means for determining ~~a~~ control range of the first flow-control-valve entrance temperature, so that a coefficient of performance (COP) value is obtained, in which the difference between the COP value and the maximum COP value obtained when the flow-control-valve entrance temperature is varied under predetermined operational conditions is within a predetermined range; and

~~a~~ control means for controlling the ~~amount~~quantity of heat exchanged in the coolant cooling means, so that the ~~coolant~~ temperature of the first coolant measured by the ~~second~~first temperature-measuring means is within the control range.

13. (Currently Amended) ~~A~~The refrigerator as ~~recited~~claimed in claim 2, further comprising:

~~a second~~first temperature-measuring means for measuring first flow-control-valve entrance temperature as ~~coolant~~ temperature ~~at the entrance~~ of the first coolant entering the first flow control valve~~;~~, wherein the heat-exchange-amount control means includes:

~~a~~ flow-control-valve-entrance-temperature control-range determination means for determining ~~a~~ control range of the first flow-control-valve entrance temperature, so that a coefficient of performance (COP) value is obtained, in which the difference between the COP value and the maximum COP value obtained when the first flow-control-valve entrance temperature is varied under predetermined operational conditions is within a predetermined range; and

~~a~~ control means for controlling the flow volume of the second coolant flowing in the coolant cooling means, so that the ~~coolant~~ temperature of the first coolant measured by the ~~second~~ temperature-measuring means is within the control range.

14. (Currently Amended) ~~A~~The refrigerator as ~~recited~~claimed in claim 1, further comprising:

~~a third~~first temperature-measuring means for measuring coolant temperature ~~at the exit~~ of the first coolant exiting the first radiator; wherein the heat-exchange-amount control means includes:

~~a~~ flow-control-valve-entrance-temperature estimation means for estimating, ~~by~~

from the temperature measured by the ~~third~~first temperature-measuring means and the ~~amount~~quantity of heat exchanged in the coolant cooling means, flow-control-valve entrance temperature as the coolant temperature ~~at the entrance~~ of the first coolant entering the first flow control valve;

~~a~~ flow-control-valve-entrance-temperature control-range determination means for determining a control range of the flow-control-valve entrance temperature, so that a coefficient of performance (COP) value is obtained, in which the difference between the COP value and the maximum COP value obtained when the flow-control-valve entrance temperature is varied under predetermined operational conditions is within a predetermined range; and

~~a~~ control means for controlling the ~~amount~~quantity of heat exchanged in the coolant cooling means, so that the flow-control-valve entrance temperature estimated by the flow-control-valve-entrance-temperature estimation means is within the control range.

15. (Currently Amended) ~~A~~The refrigerator as ~~recited~~claimed in claim 2, further comprising:

~~a third~~ temperature-measuring means for measuring coolant temperature ~~at the exit~~ of coolant exiting the first radiator; wherein the heat-exchange-amount control means includes:

~~a~~ flow-control-valve-entrance-temperature estimation means for estimating, ~~by~~from the temperature measured by the ~~third~~ temperature-measuring means and the ~~amount~~quantity of heat exchanged in the coolant cooling means, temperature ~~at the entrance~~ of coolant entering the first flow control valve as ~~coolant temperature at the entrance of the~~ flow-control-valve entrance temperature;

~~a~~ flow-control-valve-entrance-temperature control-range determination means for determining a control range of the flow-control-valve entrance temperature, so that a coefficient of performance (COP) value is obtained, in which the difference between the value and the maximum COP value obtained when the flow-control-valve entrance temperature is COP varied under predetermined operational conditions is within a predetermined range; and

~~a~~ control means for controlling ~~the~~ flow volume of the second coolant flowing in the coolant cooling means, so that the flow-control-valve entrance temperature estimated by the flow-control-valve-entrance-temperature estimation means is within the control range.

16. (Currently Amended) ~~A~~The refrigerator as ~~recited~~claimed in ~~either~~ claim 8 ~~or claim 9~~, further comprising: at least ~~either a first~~one of pressure-measuring means for measuring pressure of the first coolant between ~~the exit of~~exiting the first flow control valve

and ~~the entrance of~~entering the first evaporator, ~~or a first~~and temperature-measuring means for measuring temperature of the first coolant ~~at the exit of~~exiting the first flow control valve~~,~~, wherein the drying-ratio control-range determination means determines a control range of the drying ratio, using either the ~~coolant~~ pressure of the first coolant measured by the ~~first~~ pressure-measuring means or the ~~coolant~~ temperature of the first coolant measured by the first temperature-measuring means.

17. (Currently Amended) ~~A~~The refrigerator as ~~recited~~claimed in ~~either~~ claim 8~~or claim 9~~, further comprising~~: a second~~ pressure-measuring means for measuring pressure of the first coolant between ~~the exit of~~exiting the first radiator and ~~the entrance of~~entering the first flow control valve~~,~~, wherein the drying-ratio control-range determination means determines a control range of the drying ratio, using the ~~coolant~~ pressure of the first coolant measured by the ~~second~~ pressure-measuring means.

18. (Currently Amended) ~~A~~The refrigerator as ~~recited~~claimed in ~~any one of claims 14 to 17~~claim 12, further comprising~~:~~ at least one of ~~the first~~ pressure-measuring means for measuring pressure of the first coolant between ~~the exit of~~exiting the first flow control valve and ~~the entrance of~~entering the first evaporator, and ~~the first~~second temperature-measuring means for measuring temperature of the first coolant ~~at the exit of~~exiting the first flow control valve~~,~~, wherein the flow-control-valve-entrance-temperature control-range determination means determines a control range of the temperature ~~at the entrance~~ of the first coolant entering the first flow control valve, using ~~either~~ the ~~coolant~~ pressure of the first coolant measured by the ~~first~~ pressure-measuring means or the ~~coolant~~ temperature measured by the ~~first~~second temperature-measuring means.

19. (Currently Amended) ~~A~~The refrigerator as ~~recited~~claimed in ~~any one of claims 14 to 17~~claim 12, further comprising~~: a second~~ pressure-measuring means for measuring pressure of the first coolant between ~~the exit~~exiting of the first radiator and~~the entrance of~~ entering the first flow control valve~~,~~, wherein the flow-control-valve-entrance-temperature control-range determination means determines a control range of the temperature ~~at~~of the ~~entrance of~~first coolant entering the first flow control valve, using the coolant pressure of the first coolant measured by the ~~second~~ pressure-measuring means.

20. (Currently Amended) An air conditioner ~~having~~comprising:

a first compressor for compressing a first coolant~~,~~,

a first four-way valve for switching ~~the~~ direction in which the first coolant ~~as~~

~~outputted~~output from the first compressor flows~~;~~,

an outdoor heat exchanger for exchanging heat between the first coolant and outdoor air~~;~~,

a first flow control valve for regulating ~~the~~ flow volume of the first coolant~~; and~~,

an indoor heat exchanger for exchanging heat between the first coolant and indoor air, ~~characterized in that the air conditioner includes:~~,

~~a~~ coolant cooling/heating means for cooling ~~as well as~~ and heating the first coolant; and

~~a~~ heat-exchange-amount control means for controlling ~~the amount~~quantity of heat exchanged in the coolant cooling/heating means~~;~~, wherein

when the air conditioner is being operated for cooling, the first coolant is circulated through the first compressor, the outdoor heat exchanger, the coolant cooling/heating means, the first flow control valve, and the indoor heat exchanger, in that sequence, and

when the air conditioner is being operated for warming, the first coolant is circulated through the first compressor, the indoor heat exchanger, the first flow control valve, the coolant cooling/heating means, and the outdoor heat exchanger, in that sequence.

21. (Currently Amended) ~~An~~The air conditioner as ~~recited~~claimed in claim 20, utilizing a nonflammable coolant ~~whose~~having global warming potential ~~is~~ lower than that of chlorofluorocarbon, wherein the coolant cooling/heating means includes:

a second compressor for compressing a second coolant ~~whose~~having an energy consumption efficiency ~~is~~ higher than that of the first coolant;

a second four-way valve for switching ~~the~~ direction in which the second coolant ~~as outputted~~output from the second compressor flows;

a first heat exchanger for exchanging heat between the second coolant and outdoor air;

a second flow control valve for regulating ~~the~~ flow volume of the second coolant; and

a second heat exchanger for exchanging heat between the first coolant and the second coolant~~;~~, wherein

when the air conditioner is being operated for cooling, the second coolant is circulated through the second compressor, the first heat exchanger, the second flow control valve, and the second heat exchanger, in that sequence, and

when the air conditioner is being operated for warming, the second coolant is circulated through the second compressor, the second heat exchanger, the second flow control valve, and the first heat exchanger, in that sequence.

22. (Currently Amended) ~~An~~The air conditioner as ~~recited~~claimed in claim 20, wherein the first compressor ~~having~~has an intermediary-pressure inlet for drawing in the first coolant during compressing, the air conditioner further comprising:

a ~~third~~second flow control valve for regulating the flow volume of the first coolant ~~inputting~~input into and ~~outputting~~output from the indoor heat exchanger;

a gas-liquid separator for separating into gas and liquid the first coolant; and

a bypass pipe for introducing into the intermediary-pressure inlet at least part ~~or all~~ of the gas of the coolant ~~gas~~ separated by the gas-liquid separator; wherein

when the air conditioner is being operated for cooling, the first coolant is circulated through the first flow control valve, the gas-liquid separator, the ~~third~~second flow control valve, and the indoor heat exchanger, in that sequence, and

when the air conditioner is being operated for warming, the first coolant is circulated through the indoor heat exchanger, the ~~third~~second flow control valve, the gas-liquid separator, and the first flow control valve, in that sequence.

23. (Currently Amended) ~~An~~The air conditioner as ~~recited~~claimed in claim 20, further comprising:

a ~~third~~second compressor for compressing the first coolant as compressed by the first compressor;

a ~~third~~second flow control valve for regulating ~~the~~ flow volume of the first coolant ~~inputting~~input into and ~~outputting~~output from the indoor heat exchanger;

a gas-liquid separator for separating into gas and liquid the first coolant; and

a bypass pipe for introducing into the ~~third~~second compressor at least part ~~or all~~ of the ~~coolant~~ gas of the first coolant separated by the gas-liquid separator; wherein~~:~~,

the first coolant ~~as outputted~~output from the ~~third~~second compressor is ~~inputted~~input into the first four-way valve,~~and~~

when the air conditioner is being operated for cooling, the first coolant ~~is flowed~~flows through the first flow control valve, the gas-liquid separator, the ~~third~~second flow control valve, and the indoor heat exchanger, in that sequence, ~~meanwhile,~~and

when the air conditioner is being operated for warming, the first coolant ~~is flowed~~flows through the indoor heat exchanger, the ~~third~~second flow control valve, the gas-liquid separator, and the first flow control valve, in that sequence.

24. (Currently Amended) ~~An~~The air conditioner as ~~recited~~claimed in claim 20, further comprising:

a ~~third~~ radiator for radiating heat from the first coolant ~~as outputted~~output from the first compressor; and

a ~~third~~second compressor for compressing the first coolant ~~in a state in which~~after heat of the first coolant has been radiated ~~away~~ by the ~~third~~ radiator; and

~~a~~ flow-route changing means for inputting into the ~~third~~ radiator the first coolant ~~as outputted~~output from the first compressor when the air conditioner is being operated for cooling, and for inputting the first coolant into the ~~third~~second compressor when the air conditioner is being operated for warming.

25. (Currently Amended) ~~An~~The air conditioner as ~~recited~~claimed in claim 21, further comprising:

a third compressor for compressing the first coolant ~~as~~ compressed by the first compressor;

a third heat exchanger for exchanging heat between the first coolant and the second coolant; and

~~a~~ flow-route changing means for flowing the first coolant as ~~outputted~~output from the compressor through the third heat exchanger and the third compressor, in that sequence, when the air conditioner is being operated for cooling, and into the third compressor when the air conditioner is being operated for warming~~;~~, wherein the first coolant as ~~outputted~~output from the third compressor is ~~inputted~~input into the first four-way valve, and the second coolant as ~~outputted~~output from the second heat exchanger ~~is flowed~~flows through the third heat exchanger and the second compressor, in that sequence.

26. (Currently Amended) ~~An~~The air conditioner as ~~recited~~claimed in claim 21, further comprising:

a third compressor for compressing the first coolant ~~as~~ compressed by the first compressor;

a third heat exchanger for exchanging heat between the first coolant and the second coolant; and

a ~~forth~~third flow control valve for regulating ~~the~~ flow volume of the second coolant flowing in the third heat exchanger~~;~~, wherein

the coolant as ~~outputted~~output from the first compressor ~~is flowed~~flows through the third heat exchanger, the third compressor, and the first four-way valve, in that sequence, and

part of the second coolant ~~as outputted~~output from the first heat exchanger ~~is flowed~~flows through the ~~forth~~third flow control valve, the third heat exchanger, and the second compressor, in that sequence.

27. (New) The refrigerator as claimed in claim 14, further comprising at least one of pressure-measuring means for measuring pressure of the first coolant between exiting the first flow control valve and entering the first evaporator, and second temperature-measuring means for measuring temperature of the first coolant exiting the first flow control valve, wherein the flow-control-valve-entrance-temperature control-range determination means determines a control range of the temperature of the first coolant entering the first flow control valve, using the pressure of the first coolant measured by the pressure-measuring means or the temperature measured by the second temperature-measuring means.

28. (New) The refrigerator as claimed in claim 14, further comprising pressure-measuring means for measuring pressure of the first coolant between exiting of the first radiator and entering of the first flow control valve, wherein the flow-control-valve-entrance-temperature control-range determination means determines a control range of the temperature of the first coolant entering the first flow control valve, using the coolant pressure of the first coolant measured by the pressure-measuring means.